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THE EFFECT OF OEDEMAGENA TARANDI LARVAE ON THE SKIN OF REINDEER

(Reaktivnye izmeneniya kozhi severnogo olenya pri
vnedrenii lichinok kozhnogo ovoda)

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THE EFFECT OF OEDEMAGENA TARANDI LARVAE ON THE SKIN OF REINDEER

(Reaktivnye izmeneniya kozhi severnogo olenya pri vnedrenii lichinok kozhnogo ovoda)

S.P. ALFEEVA and Academician E.N. PAVLOVSKII

The Zoological Institute of the Academy of Sciences of the USSR and the Department of General Biology and Parasitology of the Military Medical Academy im. S.M. Kirov

Research has demonstrated the excellence of reindeer skin for use in the manufacture of chamois and box calf for footwear; its capacity for gaseous exchange and thermal regulation is not inferior to that of the higher grades of kid. However, up to 60% of the skin surface is condemned and rejected by the time the finishing processes are completed. The majority of this damage is caused by warble fly larvae (Figures 1, 2) Oedemagena tarandi (Voskresenskii and others, 1935). These are found by the hundreds, in one deer even reaching as many as 1177 (Vinogradova, 1936). The skin assumes the appearance of a sieve and is unfit for technical usage.

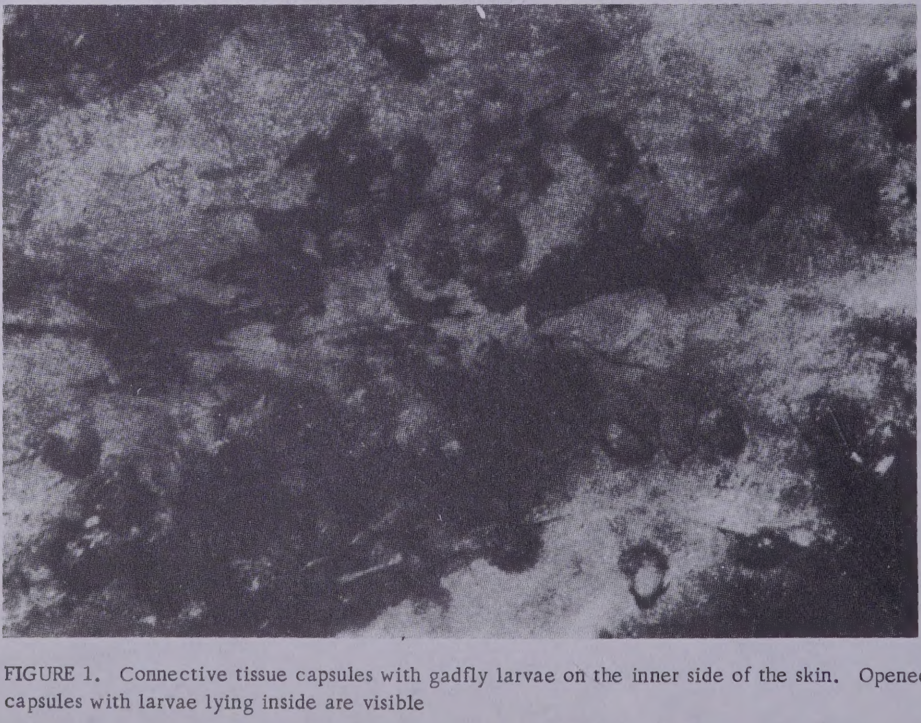

FIGURE 1. Connective tissue capsules with gadfly larvae on the inner side of the skin. Opened capsules with larvae lying inside are visible

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In addition, deer become very emaciated due to the parasitism of the warble fly larvae, and the meat loses its taste and nutritive properties; furthermore, the slaughter weight is considerably reduced.

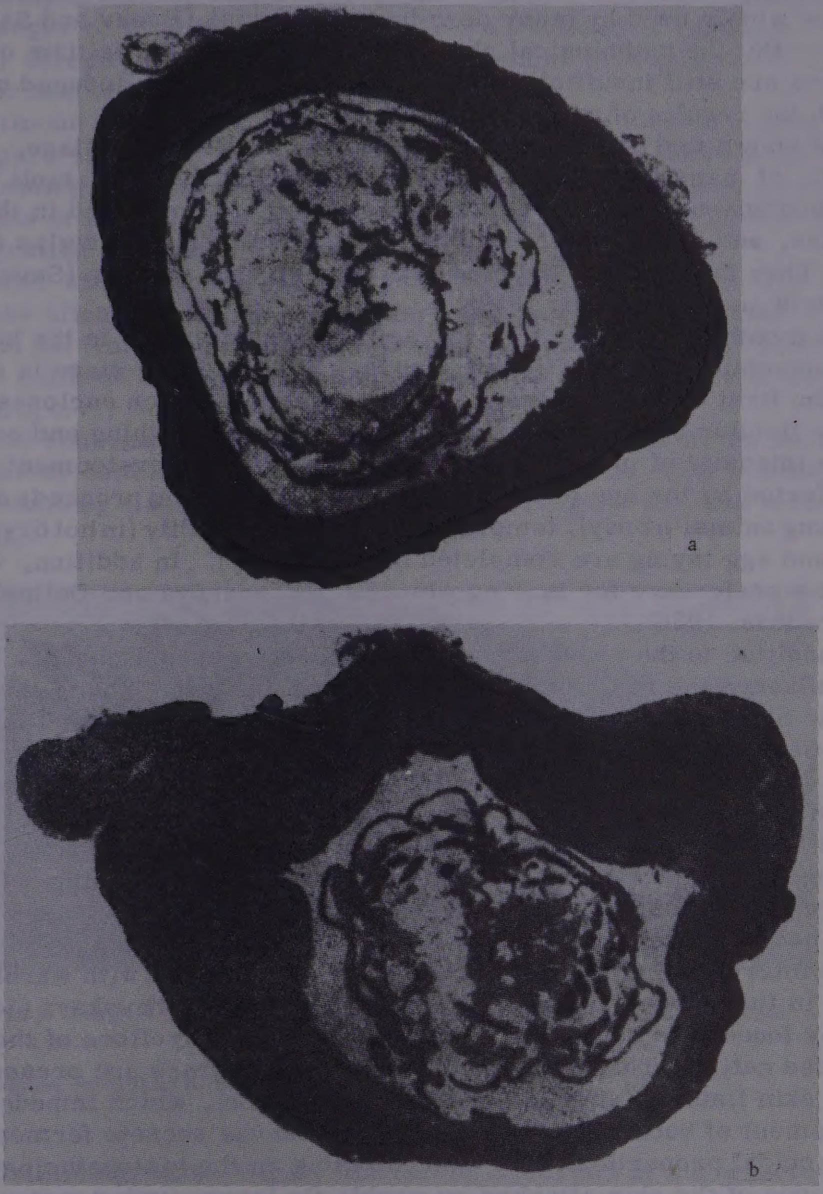

FIGURE 2. Compact capsule surrounding larva (cross-sections at different levels). Low magnification

174 Because of the widespread losses to deer breeding caused by warble flies, a series of expeditions were organized by the Arctic Institute (1930-1935; Sdobnikov, Vinogradova, Nakhlupin, Terent'ev), the Northern and Kola peninsular bases and the Zoological Institute of the Academy of Sciences, USSR (1936-1938 and 1945-1950; Breev, Karazeeva, Grebel'skii), and the Scientific Agricultural Research Institute of the Far North (from

1949; Breev, Savel'ev, Mitskevich, Baskakov, Voblikova), to study the biology of the warble fly, the conditions under which infection takes place, and practical measures for its control.

These efforts proved successful, and the control measures thus evolved 175 are now widely used by many deer-breeding farms (Breev and Savel'ev, 1958)*. But the pathological changes caused by the parasitism of warble fly larva are still insufficiently investigated. This has induced us to publish the results of our investigations.

It is known that subcutaneous warble fly, in the larval stage, is a parasite of mammals; larvae grow in the body of the host, molt twice in the subcutaneous connective tissue where they lie embedded in thickened capsules, and exit by their posterior end, thus forming fistulas in the skin. They then fall off and pupate in the external medium (Savvantov, 1903; Nakhlupin and Pavlovskii, 1932).

The monthly distribution of larvae in different stages in the host has been ascertained with sufficient accuracy. The second stage is distinguished from the first by the appearance of the capsule — which encloses the larva — and the fistular duct — required by the larva for breathing and eventual exit.

The intensity of infection and the speed of larval development in the host are affected by the age of the deer (larval development proceeds more quickly in a young animal's body), temperature, and air humidity (in hot dry seasons flight and egg laying are completed more rapidly). In addition, warble flies exhibit a preference for moving white deer (Zhdanova and Dolinskaya, 1934; Vinogradova, 1936).

In addition to the above-mentioned factors, seasonal changes in the host influence the reaction in the deer's skin tissues. Thus, examination of white blood cells of reindeer at different times of the year (Solomko, 1936) has shown that where a general infection of reindeer by warble fly larvae or helminths takes place, the quantity of basophils increases from 4.2 to 8.5% (by segmentation of their nuclei), and a still greater increase occurs in the quantity of eosinophils — up to 26%. But in such a mixed infection it is difficult to determine whether the larvae or the helminths produce these changes in the host leukocytes. In other diseases of deer (e.g., hoof disease) basophils disappear entirely (Solomko, 1936).

The microflora of the fistular ducts in deer's skin, with warble fly larvae in them, was studied by Kasatkevich and Karchevskaya (1934), but they found it to be insignificant, not like the microflora of the fistulas of horned cattle. These authors assume that enzymes are present in the deer's skin fistulas (amylase, lipase, proteolase), which impede the development of bacteria (it is feasible that larvae secrete ferments with bacteriocidal properties). By concentrating on the histopathological study of portions of the skin attacked by warble fly larvae (using material collected by K. Breev in 1937 in the Timan tundra), the following data were obtained.

Authors' Research

Twelve pieces of deer skin damaged by warble fly and five warble fly larvae in connective tissue capsules formed the material for investigations.

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* The booklet by K. A. Breev and D. V. Savel'ev gives a complete list of publications on warble fly in reindeer.

After fixation in formalin, the material was poured into celloidin; the sections were stained with hemotoxylin and eosin (by the Van Gizon method) and with pyridin-eosin-azure.

Larval stages lacking connective tissue capsules were not examined. Usually, larger or smaller sized larvae were enclosed in capsules (Figure 3a) directly connecting through the fistular duct (Figure 3b) with the surface of the skin (Figure 3c).

176 The chitinous cuticle that is shed during molting often lies beside the larvae (Figure 4a, b). In the host tissues adjacent to the larva's surface, cellular disintegration is noticeable (Figure 4c). The tissue of the capsule wall consists of distinct granular elements, but in places is also affected by disintegration (Figure 4d).

In the later stages of connective tissue capsule development, the cuticle that remains after molting becomes surrounded by granular tissue. Side by side with perivascular cell concentrations there are concentrations of degenerate cells or even homogeneous masses of disintegrated matter (Figure 5a, b, c, d).

Localized concentrations of black spikelets are visible on the surface of the chitinous cuticle of post-molt larvae (Figure 6a). Cell disintegration in the surrounding tissue is even more marked (Figure 6b) than before (Figure 5d).

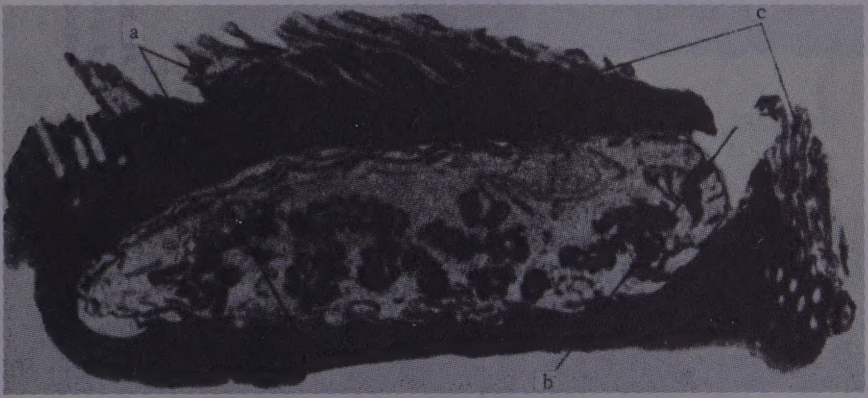

FIGURE 3. Longitudinal section of subcutaneous connective tissue capsule with warble fly larva inside

a—capsule; b—fistular passage; c—skin surface

Further disintegration (Figure 7b) can be observed at the anterior end of the larva (Figure 7a) in the fistular opening, which is gradually freed as the larva moves, posterior end forward, towards the host's skin surface.

The cells in the fistular passage gradually change in character; in place of formless disintegration, fibroblast-cells with outgrowths (Figure 8a) appear, gradually narrowing the fistula opening. This narrowing is better expressed during later stages (Figure 9a); the granular tissue assumes a markedly fibrous appearance and, finally, giant cells appear (Figure 9b), resembling the giant Langerhans cells of tuberculosis.

After complete closure of the fistular passage following the emergence of the larva, thick scar tissue forms in the fibrous tissue of the skin

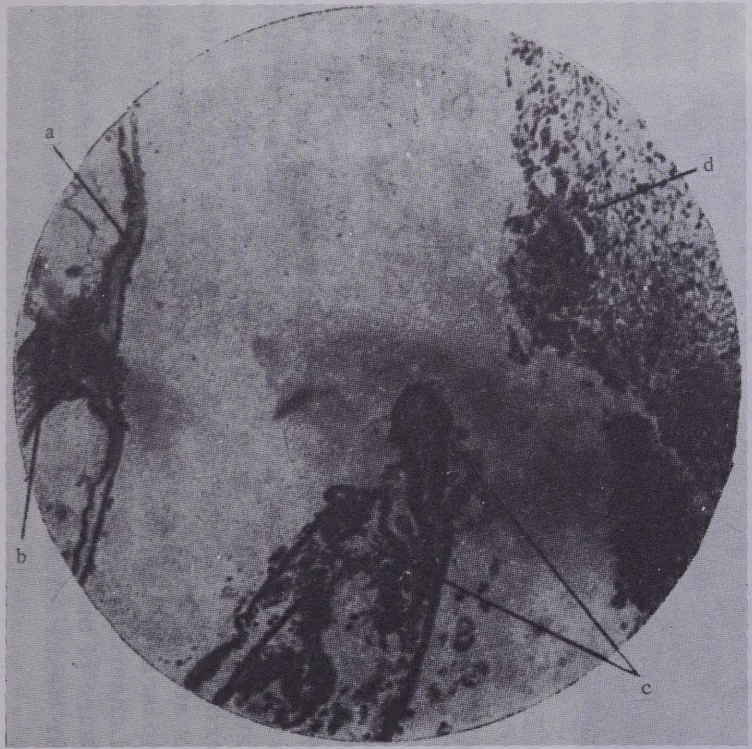

FIGURE 4. Cross-section of a portion of capsule

a—portion of larva cuticle; b—muscle attached to it; c—remains of cuticle cast off by larvae; d—granular tissue of the capsule wall in places of disintegration

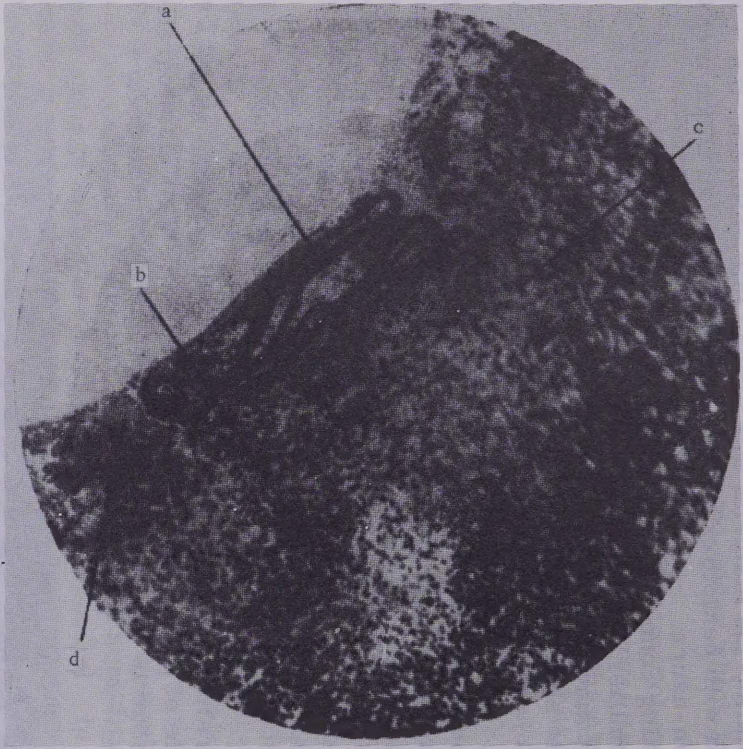

FIGURE 5. Chitinous cuticle cast off by larva during molting (a) in the midst of granular host tissue. Perivascular concentration of cells visible (b); degenerated cells (c); disintegration (d); Microphotograph

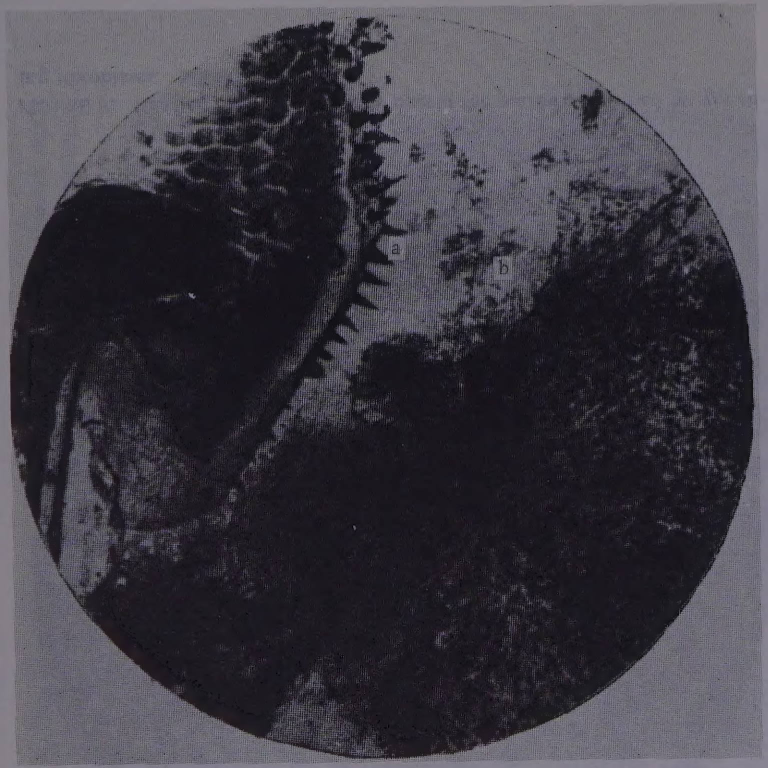

FIGURE 6. Portion of larva cuticle with chitinous spikes (a); disintegration of tissue cells surrounding the larva visible (b)

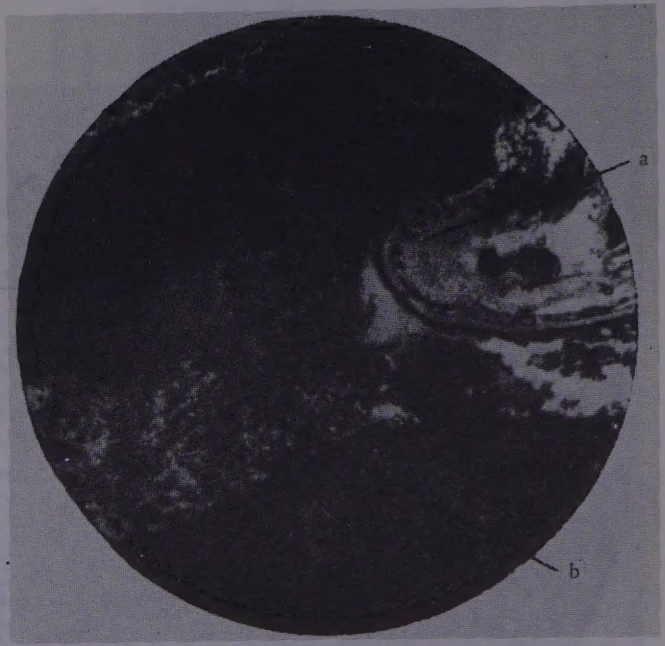

FIGURE 7. Passage (a) at the anterior end of warble fly larvae. Disintegration of cells is visible (b). Microphotograph

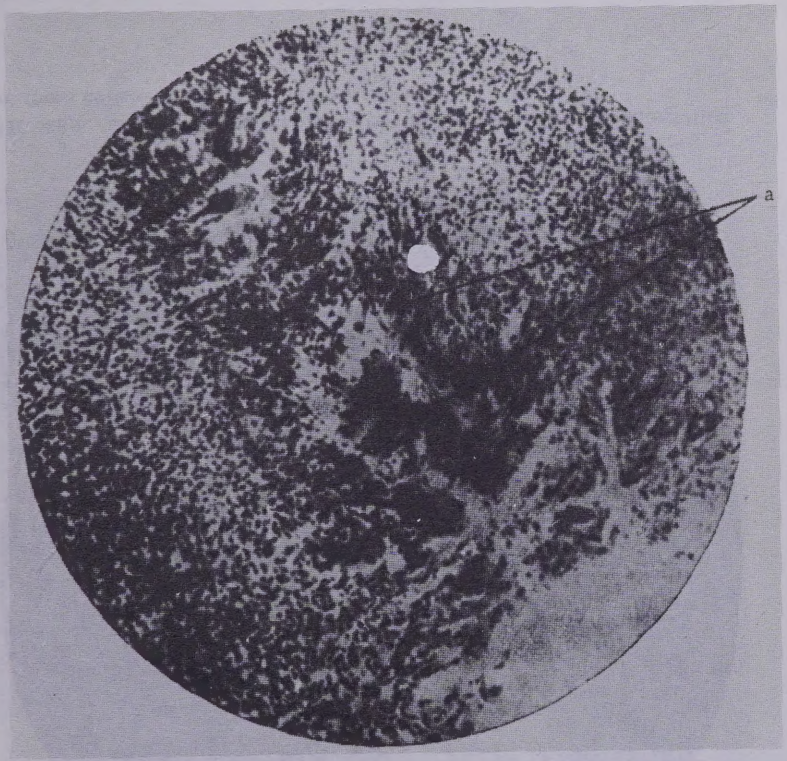

FIGURE 8. Healing of fistular passage due to the narrowing caused by spreading fibroblasts. Microphotograph

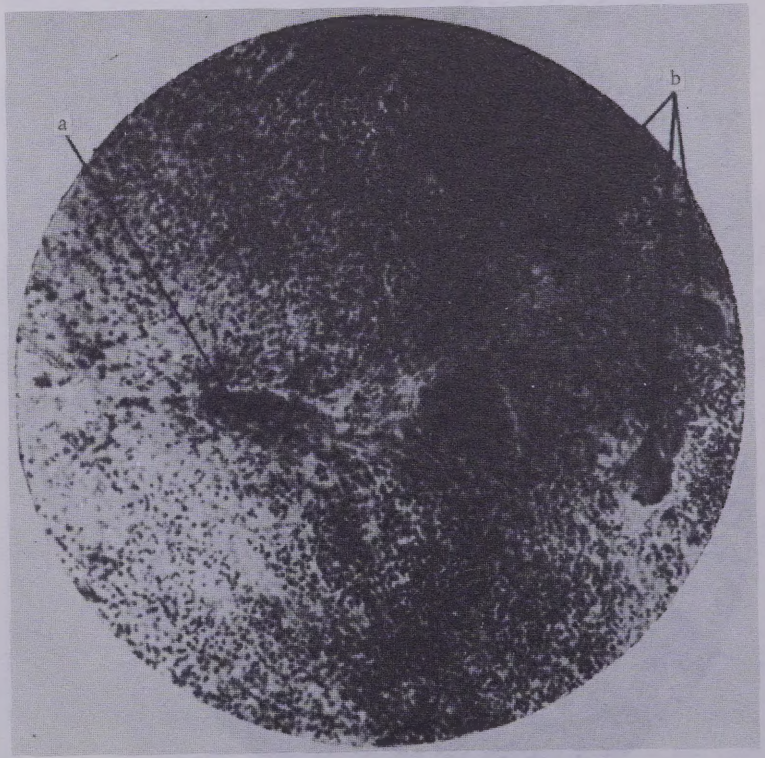

FIGURE 9. Closure of fistular passage (a) by fibrous connective tissue, with formation of giant cells (b). Microphotograph

(Figure 10a) and in the subcutaneous cellular tissue (Figure 10b). This area is completely bare (Figure 10c). Epidermis on the surface usually grows actively and spreads into the fistular passage.

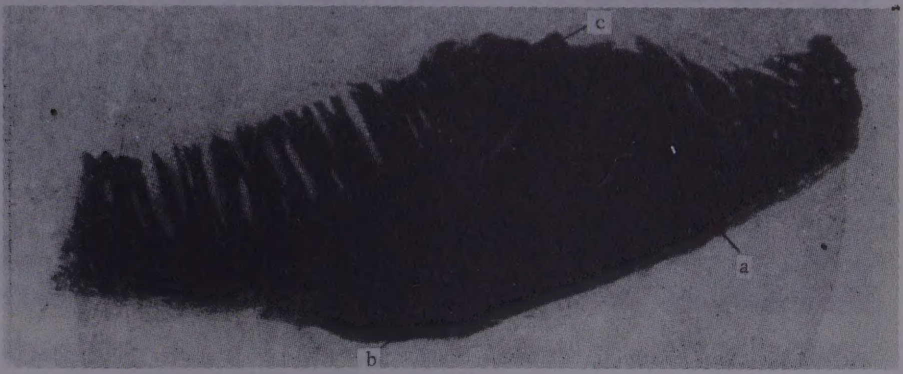

FIGURE 10. Massive scar of the fibrous portion of the skin (a) and subcutaneous cellular tissue (b), with disappearance of hair (c). Microphotograph

The massive size of the scar tissue is due to the presence, enmeshed in the granular fibrous tissue, of remnants of the chitinous cuticle (Figure 11a) with the sharp black spikelets (Figure 11b) shed during molting; the chitinous cuticle shows no signs of any change.

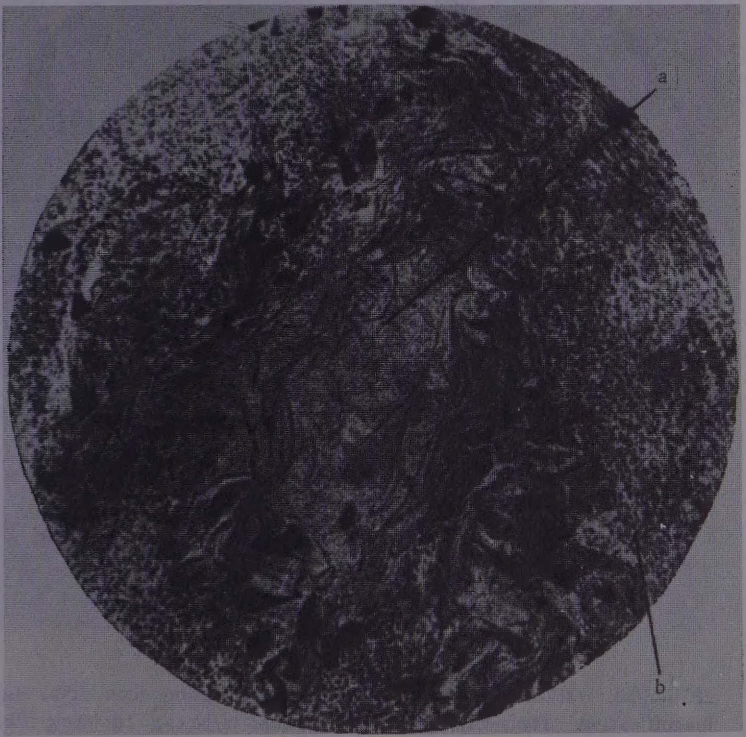

FIGURE 11. Remnants (a) of larva cuticle with chitinous spikes in the granular connective tissue (b). High magnification. Microphotograph

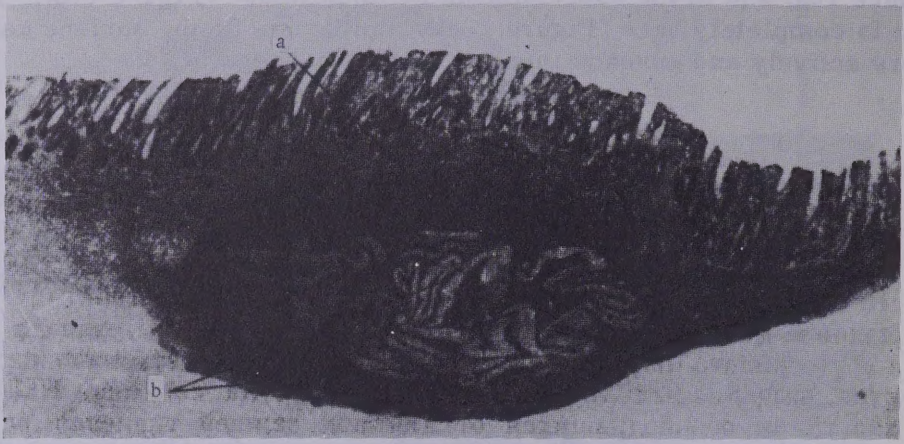

FIGURE 12. The perished larva in the subcutaneous cellular tissue of deer, surrounded by dense capsule (a). Swollen chitinous cuticle with numerous folds (b). Shrivelled internal organs of larva. Microphotograph

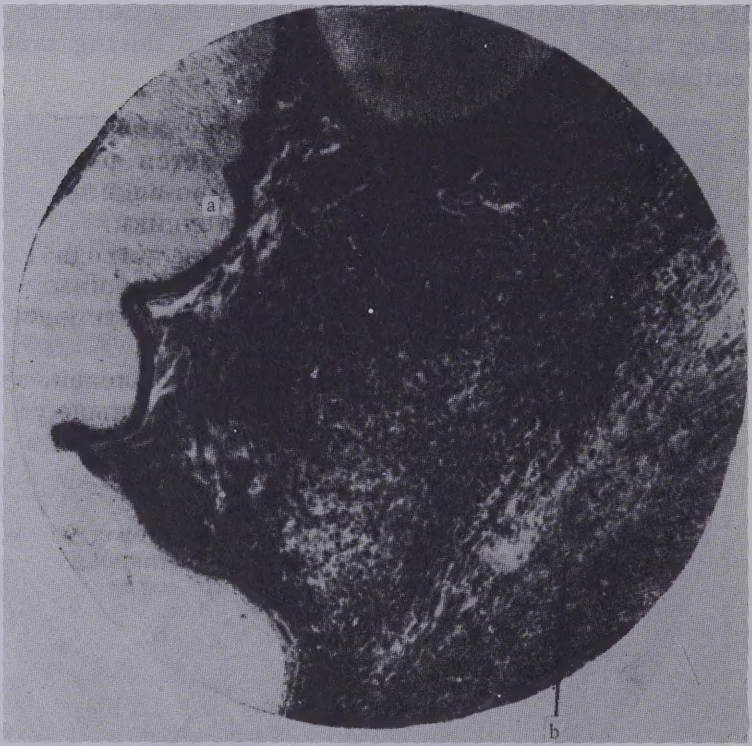

FIGURE 13. Wall of connective tissue capsule surrounding dead larva. High magnification. The swollen cuticle of the dead larva (a); bordering fibroblasts and giant cells (b) surrounded by fibrous connective tissue (c). Microphotograph

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180 In some cases the warble fly larva perishes in the capsule. Depending
on the time of its destruction, it is surrounded on all sides by a more or
less dense fibrous capsule of its host's tissues (Figure 12a) — the fistular
passage has not formed. The dead larva undergoes changes: the chitinous
cuticle swells, numerous folds appear (Figure 12b), all the internal organs
shrivel. In these cases, the difference in the host's connective tissue
reaction can be seen under powerful magnification. Granular tissue lies
182 contiguous with the swollen cuticle of the dead larva (Figure 13a), with
dendritic cells predominating, small giant cells (Figure 13b), and finally
the fibrous connective tissue of the capsule (Figure 13c).

Results

The development, in conformity with a uniform pattern, of warble fly larvae in the host's body always coincides with the expressed peculiarities in the seasonal changes of reindeer's tissue reactions (Ivanov and Nikolaevskii, 1936).

The difference in tissue reactions at the place of contact, either to the live parasite or to the dead larva, is of considerable interest. The predominance of degenerate forms and the mass of disintegrated matter in the tissues around the live parasite point to the direct action of larval secretions on the host's body cells. Conversely, during the closure of fistulas freed from larvae, the tissue reaction is characterized by the development of fibrous tissue. Sometimes giant cells appear where foreign bodies of nonanimal origin are present.

The prevalence of necrosis and disintegration without leukocyte reaction conforms to the results of microflora of fistular passage research carried out by Kasatkevich and Karchevskaya (1934).

The size of the scars depends on the presence in the body of cast-off chitinous cuticles, especially those with the dense black spikelets, which remain for long periods in the scar tissue without any signs of disintegration.

Conclusions

1. The growth of connective tissue around the warble fly larvae in the subcutaneous cellular tissue of reindeer is accompanied by a markedly expressed necrosis of the host's body cells, evidently stimulated by larval secretions.
2. During motion, and subsequently also during the parasite's exit, the healing of fistulas and disappearance of connective tissue growths are impeded by the presence of chitinous cuticles, cast off during molting, with particularly persistent black spikelets.
3. In the drive to secure good quality reindeer skins and to successfully apply prophylactic measures, one must remember that the earlier the larvae are killed, the smaller the defect remaining in the skin.

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